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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/867,711	05/31/2001	Kirsten Matheus	2789-38	6201

7590 11/17/2004  
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EXAMINER

LEE, ANDREW CHUNG CHEUNG

ART UNIT PAPER NUMBER

2664

DATE MAILED: 11/17/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/867,711

Applicant(s)

MATHEUS ET AL.

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Examiner

Andrew C Lee

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 31 May 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1 - 22 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 10 is/are allowed.
- 6) ☒ Claim(s) 1-9; 11-22 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
- 1) ☒ Certified copies of the priority documents have been received.
  - 2) ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - 3) ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date Apr 18, 2002.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Specification*

1. The disclosure is objected to because of the following informalities:
  - Page 1, line 2, the term "mult l-carrier" should be corrected as "multi-carrier"
  - Page 5, Equation (1), the term " $d_m(i)$ " should be corrected as  $d_n(i)$  and  $C_m(i)$  be corrected as  $C_n(i)$ .
  - Page 9, Equation (6), the term " $C_{est, n}$ " should be corrected as " $C_{est, n(i)}$ ".
  - Page 10, line 10, the term " $\square_{est, 2(i)}$ " is not defined and is not consistent with Equation (7) as disclosed.
  - Page 10, Equation (7), the term " $C_{est, n}$ " should be corrected as " $C_{est, n(i)}$ ".
  - Page 11, line 7, the term " $\square_{est, 3(i)}$ " is not defined and is not consistent with Equation (8) as disclosed.
  - Page 11, Equation (8), the term " $C_{est, n}$ " should be corrected as " $C_{est, n(i)}$ ".
  - Page 11, line 19, the term " $\square_{est, 4(i)}$ " is not defined and is not consistent with Equation (9) as disclosed.
  - Page 11, Equation (9), the term " $C_{est, n}$ " should be corrected as " $C_{est, n(i)}$ ".
  - Page 12, line 24, Fig.1 is referred to, but there is not any drawing in the disclosure; line 21, the open bracket "(" before determined should be deleted.
  - Page 14, line 4, the terms " $\square_{est, 1}$  and  $\square_{est, 3}$ " need to be clarified.

- Page 27, lines 19 and 23, the terms “est , off , est , 1 , est , 2, est , 3 and est , 4 “ need to be clarified.
- Line numbering for the specification, abstract and claims is required or the paragraphs of the specification, other than in the claims or abstract, may be numbered at the time of the application is filed, and should be individually and consecutively numbered using Arabic numerals, so as to unambiguously identify each paragraph. The number should consist of at least four numerals enclosed in square brackets, including leading zeros (e.g., [0001])

Appropriate correction is required.

2. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

### ***Claim Objections***

3. Claim 14 is objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim “accordance with one or more of claims 1 – 10 or one or more of claims 11 –13”. See MPEP § 608.01(n). Accordingly, the claim 14 has not been further treated on the merits.

***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1- 2, 7 – 9, are rejected under 35 U.S.C. 102(e) as being anticipated by Keevill et al. (U.S. Patent No. 6359938 B1).

Regarding Claim 1, Keevill et al. discloses the limitation of Frequency tracking device (FTD) for a receiver (RC) of a multi-carrier communication system (MC-SYS) (Fig.4, Abstract, lines 2 – 3), for evaluating and correcting frequency deviations ( $f_{\text{off}}$ ) which are introduced into multi-carrier symbols (column 4, lines 11– 15) when being transmitted between a transmitter multi-carrier filter bank (4; IFFT) (Fig. 4, element 24) and receiver multi-carrier filter bank (8; FFT) (Fig. 41, element “FFT”), comprising:

a) a selector (SEL) adapted to receive a set of N complex data symbols output by the receiver multi-carrier filter bank (8; FFT) (column 18, Fig. 14, element 166 and the bit-reversed order data stream I&Q) and N channel coefficients ( $C_{\text{est}}$ ) corresponding to each sub-carrier as estimated by a channel estimator (12) of said receiver (RC) (column 18, lines 32 – 33 ), where N is the number of used sub-carriers in the multi-carrier system (MC-SYS) (column 2, line 4), and adapted to select, on the basis of the N

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channel coefficients ( $C_{est}$ ), a number  $M$  of sub-carriers corresponding to the  $M$  channel coefficients ( $C_{est}$ ) having the largest absolute values, where  $M \leq N$  (column 5, lines 58 – 65 ); b) an evaluator (EVAL) adapted to determine, on the basis of the  $M$  selected sub-carriers and their corresponding  $M$  channel coefficients ( $C_{est}$ ) ( column 26, lines 60 – 62), an estimate ( $f_{off,est}$ ) of the frequency deviation ( $f_{off}$ ) introduced into the multi-carrier symbols (column 62, lines 57 – 59); and c) a corrector (CORR; CORR2) for correcting the frequency deviation introduced into the multi-carrier symbols on the basis of the determined frequency deviation estimate ( $f_{off,est}$ ) (Fig. 14, element 170; column 26, lines 55 – 62).

Regarding Claim 2, Keevill et al. discloses the limitation of Frequency tracking device (FTD) according to claim 1, wherein said selector (SEL) adaptively adjusts the number  $M$  at adjustment time intervals including at least one multi-carrier symbol duration (column 11, lines 49 – 53).

Regarding Claims 7, Keevill et al. discloses the limitation of Frequency tracking device (FTD) according to claim 1, wherein said evaluator (EVAL) is adapted to carry out a decision directed evaluation for said  $M$  sub-carriers (Fig. 14, column 26 lines 53 – 63).

Regarding Claim 8, Keevill et al. discloses the limitation of Frequency tracking device (FTD) according to claim 1, wherein said evaluator (EVAL) is adapted to carry out a pilot carrier aided evaluation for said M sub-carriers (Fig. 14, column 26, lines 65 – 67; column 27, lines 1 – 3).

Regarding Claim 9), Frequency tracking device (FTD) according to claim 1, wherein said evaluator (EVAL) is adapted to carry out a combination of a decision directed evaluation and a pilot carrier aided evaluation for said M subcarriers (Fig. 14, column 27, lines 11 – 20).

### ***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 3 – 6, 11 – 22, are rejected under 35 U.S.C. 103(a) as being unpatentable over Keevill et al. (U.S. Patent No. 6359938 B1) in view of the article “Optimum Receiver Design for OFDM-Based Broadband Transmission — Part II: A Case Study” by Speth Et al.

Regarding Claims 3 – 4, 6, 12, Keevill et al. discloses the limitation of Frequency tracking device (FTD) for a receiver (RC) of a multi-carrier communication system (MC-SYS) (Fig.4, Abstract, lines 2 – 3) and a corrector (CORR; CORR2) for correcting the frequency deviation introduced into the multi-carrier symbols on the basis of the determined frequency deviation estimate ( $f_{\text{off,est}}$ ) (Fig. 14, element 170; column 26, lines 55 – 62 ), Keevill does not disclose expressly Frequency tracking device (FTD) according to claim 1, wherein said corrector (CORR1; CORR2) includes: a first correction unit (CORR1) arranged upstream the receiver multi-carrier filter bank (8), and adapted to rotate each received multi-carrier symbol with a different phase shift depending on the frequency deviation estimate ( $f_{\text{off,est}}$ ), and the sample index (k) within the multi-carrier symbol; and a second correction unit (CORR2) arranged downstream of the receiver multi-carrier filter bank (8), and adapted to rotate all data symbols output by the multi-carrier filter bank (8) with the same phase shift depending on the frequency deviation estimate ( $f_{\text{off,est}}$ ). Speth discloses the limitation of Frequency tracking device (FTD) according to claim 1, wherein said corrector (CORR1; CORR2) includes: a first correction unit (CORR1) arranged upstream the receiver multi-carrier filter bank (8) ( p.572, Fig. 2, element “Pre-FFT estimation”), and adapted to rotate each received multi-carrier symbol with a different phase shift depending on the frequency deviation estimate ( $f_{\text{off,est}}$ ), and the sample index (k) within the multi-carrier symbol (p. 574, column 2, the last paragraph 2) Pre-FFT Carrier Frequency Acquisition; p.575, column 1, first paragraph eq. (7) and eq.(8) ); and a second correction unit (CORR2) arranged downstream of the receiver multi-carrier filter bank (8) (p.572, Fig. 2, element “Post-FFT



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estimation”), and adapted to rotate all data symbols output by the multi-carrier filter bank (8) with the same phase shift depending on the frequency deviation estimate ( $f_{\text{off,est}}$ ) (p.575, column 1, the paragraph 3) Post-FFT Carrier Frequency Acquisition and column 2, paragraph 4) Post-FFT Carrier and Sampling Frequency descriptions). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Keevill et al. to include Frequency tracking device (FTD) according to claim 1, wherein said corrector (CORR1; CORR2) includes: a first correction unit (CORR1) arranged upstream the receiver multi-carrier filter bank (8), and adapted to rotate each received multi-carrier symbol with a different phase shift depending on the frequency deviation estimate ( $f_{\text{off,est}}$ ), and the sample index (k) within the multi-carrier symbol; and a second correction unit (CORR2) arranged downstream of the receiver multi-carrier filter bank (8), and adapted to rotate all data symbols output by the multi-carrier filter bank (8) with the same phase shift depending on the frequency deviation estimate ( $f_{\text{off,est}}$ ). as that taught by Speth et al. in order to have better improvement of receiver performance.

Regarding Claim 5, Keevill et al. discloses the limitation of Frequency tracking device (FTD) according to claim 4, wherein said second correction unit (CORR2) performs a correction of the same set of N data symbols which are subjected to the selection by said selector (SEL) (Fig. 14, column 27, lines 1- 10; column 28, lines 20 – 26).

Regarding Claims 11, 16 – 22, Keevill et al. discloses the limitation of Frequency

tracking device (FTD) for a receiver (RC) of a multi-carrier communication system (MCSYS) (Fig. 4, Abstract, lines 2 – 3), for evaluating and correcting frequency deviations ( $f_{\text{off}}$ ) which are introduced into multi-carrier symbols (column 4, lines 11 – 15) when being transmitted between a transmitter multi-carrier filter bank (4; IFFT) (Fig. 4, element 24) and receiver multi-carrier filter bank (8; FFT) (column 18, Fig. 14, element 166 and the bit-reversed order data stream I&Q), comprising: a) an evaluator (EVAL) adapted to receive a set of N complex data symbols output by the receiver multi-carrier filter bank (8; FFT) and N channel coefficients ( $C_{\text{est}}$ ) corresponding to each sub-carrier as estimated by a channel estimator (12) of said receiver (RC) (column 18, lines 32 – 33), where N is the number of used sub-carriers in the multi-carrier system (MCSYS) (column 2, line 4), and to determine, on the basis of N sub-carriers and their corresponding N channel coefficients ( $C_{\text{est}}$ ), an estimate ( $f_{\text{off,est}}$ ) of the frequency deviation ( $f_{\text{off}}$ ) introduced into the multi-carrier symbols, where N is the number of sub-carriers used in the transmitter (column 5, lines 58 – 65); b) a corrector (CORR1; CORR2) for correcting the frequency deviation introduced into the multi-carrier symbols on the basis of the determined frequency deviation estimate ( $f_{\text{off,est}}$ ) (Fig. 14, element 170; column 26, lines 55 – 62); Keevill does not disclose expressly wherein said corrector (CORR1; CORR2) includes a second correction unit (CORR2) arranged downstream of the receiver multi-carrier filter bank (8), and adapted to rotate all data symbols output by the receiver multi-carrier filter bank (8) with the same phase shift depending on the frequency deviation estimate ( $f_{\text{off,est}}$ ). Speth et al. discloses wherein

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said corrector (CORR1; CORR2) includes a second correction unit (CORR2) arranged downstream of the receiver multi-carrier filter bank (8) (p.572, Fig. 2, element "Post-FFT estimation"), and adapted to rotate all data symbols output by the receiver multi-carrier filter bank (8) with the same phase shift depending on the frequency deviation estimate ( $f_{\text{off,est}}$ ) ( p.575, column 1, the paragraph 3) Post-FFT Carrier Frequency Acquisition and column 2, paragraph 4) Post-FFT Carrier and Sampling Frequency descriptions). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Keevill et al. to wherein said corrector (CORR1; CORR2) includes a second correction unit (CORR2) arranged downstream of the receiver multi-carrier filter bank (8), and adapted to rotate all data symbols output by the receiver multi-carrier filter bank (8) with the same phase shift depending on the frequency deviation estimate ( $f_{\text{off,est}}$ ) as that taught by Speth et al. in order to have better improvement of receiver performance.

Regarding Claim 13, Keevill et al. discloses the limitation of Frequency tracking device (FTD) according to claim 11, further comprising a selector (SEL) adapted to receive a set of N complex data symbols output by the receiver multi-carrier filter bank (8; FFT) (column 18, Fig. 14, element 166 and the bit-reversed order data stream I&Q) and N channel coefficients ( $C_{\text{est}}$ ) corresponding to each sub-carrier as estimated by a channel estimator (12) of said receiver (RC) (column 18, lines 32 –33), where N is the number of used sub-carriers in the multi-carrier system (MCSYS) (column 2, line 4), and adapted to select, on the basis of the N channel coefficients ( $C_{\text{est}}$ ), a number M of sub-carriers corresponding to the M channel coefficients ( $C_{\text{est}}$ ) having the largest absolute

values, where  $M \leq N$  (column 5, lines 58 – 65); and wherein said evaluator (EVAL) is adapted to determine, on the basis of the  $M$  selected sub-carriers and their corresponding  $M$  channel coefficients ( $C_{est}$ ), an estimate ( $f_{off,set}$ ) of the frequency deviation ( $f_{off}$ ) introduced into the multi-carrier symbols (column 26, lines 53 – 63).

Regarding Claim 14, Keevill et al. discloses the limitation of Receiver (RC) (Fig. 4, element 32) of a multi-carrier communication system (MC-SYS) (Abstract, lines 2 – 3), comprising reception means (RM) for receiving multi-carrier symbols transmitted from a transmitter (TR) via a transmission channel (6), a receiver multi-carrier filter bank (8) for converting said multi-carrier symbols into complex data symbols (Fig. 41, the element “FFT”; column 33, lines 37 – 43), a data symbol sink (11) for receiving said data symbols (Fig. 14, element 166; column 18, lines 29 – 31) and a frequency tracking device (FTD) (Fig. 174, element 174; column 18, lines 37 – 41) in accordance with one or more of claims 1-10 or one or more of claims 11-13.

Regarding Claim 15, Keevill et al. discloses the limitation of a multi-carrier communication system (MC-SYS) (Fig. 4, Abstract, lines 2 – 3), comprising at least one transmitter (TR) including a data symbol source (1-3) generating complex data symbols (Fig. 4, column 3, lines 1 – 5), a transmitter multi-carrier filter bank (4) for generating multi-carrier symbols from said complex data symbols (Fig. 4, element 24; column 3, lines 15 – 18) and a transmission means (TR) for transmitting said multi-carrier symbols onto a transmission channel (6) (column 3, lines 19 – 22), and at least one receiver

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(RC) (Fig. 4, element 32; column 3, line 22) in accordance with claim 1

***Allowable Subject Matter***

8. Claim 10 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

***Conclusion***

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrew C. Lee whose telephone number is (571) 272-3131. The examiner can normally be reached on Monday through Friday from 8:30am - 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wellington Chin can be reached on ((571) 272-3134. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ACL  
02-11-2004

  
**Ajit Patel**  
**Primary Examiner**